Fluor-BWXT | Portsmouth

ENGINEERING EVALUATION COVERSHEET

Number: EVAL-DE-2017-0136 **ESO#/PR#/NCR#:** E5974
Revision: 1 **Duration:** One Time Only
Type: Engineering
Title: X-744G and X-720 Roof Assessments for Placement of Equipment and Materials
Doc Link:
Final Doc Link:

Description/Evaluation Statement:

Revision 1 includes removing the AES Raptor mobile fall protection equipment information from this Engineering Evaluation and adding reference to EVAL-DE-2018-0421 due to new limitations/restrictions when using on 18 gauge metal roof decking. Also, revision 0 was written for Contractor work; however, this Evaluation is also intended for maintenance use. If there are any questions regarding point loading, contact Engineering for further clarification.] R1

SUMMARY/CONCLUSION

Revision 1 includes removal of the vendor information for the AES Raptor mobile fall protection equipment. For additional information/limitations/restrictions regarding use of the equipment, refer to Engineering Evaluation, EVAL-DE-2018-0421.] R1

To support the X-744G and X-720 roof repairs, this Engineering Evaluation assesses the allowable roof loading for placement of equipment and materials on the roofs. The Contractor has used similar equipment and materials on other roofs onsite and there were no previous issues noted due to roof loading. In addition, this Engineering Evaluation gives approval for exceeding the number of personnel that are limited in the roof structural integrity Engineering Evaluations as listed below, as long as the allowable point loads are not exceeded per roof structural steel member or width as designated in the attached discussions per each roof.

The roofs have been inspected for roof structural integrity per the two evaluations listed below, and there are no restricted areas that limit access to the roofs. However, caution is to be used when using heavy equipment on the roof. There is no evidence showing that the roof will not handle the anticipated roof loads; however, the older metal decking does shows signs of past corrosion with some type of overlay on top. Drawings could not confirm that the overlay is new metal decking, etc. Please proceed with caution and watch for any changing conditions that may impact structural integrity.

The general roof structural integrity inspections are documented in the following Engineering Evaluations:
•EVAL-DE-2014-0284 – X-744G Roof Structural Integrity Assessment
•EVAL-DE-2012-0113 – X-720 Roof Inspection Report

For both the X-744G and the X-720 roofs, the maximum allowable point load is 1,334 lbs (if TPO is not installed) or 1,267 lbs (if TPO is installed). Personnel must ensure that the weight of a person, equipment, and tools do not exceed the maximum point load. This maximum point load is allowed for a tributary area within one roof purlin/joist. So, ensure a minimum of 7 ft. between equipment/heavy loads in the north/south direction and 20 ft. minimum between equipment/heavy loads in the east/west direction. Workers need to distribute equipment/materials/personnel as much

as possible to not heavily load a certain area. When feasible, please try to maneuver/place the heaviest equipment over top of roof purlins/joists. Roof purlins/joists are spaced approximately 6.7 ft. (north/south) and 20 ft. (east/west).

COMPUTATIONS FOR X-744G BULK STORAGE BUILDING (Also applies to X-720)

The X-744G drawings for the structure (showing joist/column/etc. information) could not be found at the time that this Engineering Evaluation was written; however, it is assumed that every roof onsite has at least a minimum allowable live load to account for snow roof loading of 20 psf. If the roof work is performed with no significant snow accumulation or ponding water, then this 20 psf could be considered for the minimum allowable live load. To translate the 20 psf over a typical roof purlin with a span of approximately 20 ft. and a width of approximately 6.67 ft. (it appears that there are three spans within a 20 ft. section on drawing X-744G-106-A), the 20 psf needs to be turned into a linear uniformly distributed load, so 20 psf*6.67ft = 133.4 lb/ft = "w". Then this term, "w", is used to determine the allowable maximum moment of the roof purlin, which will be used to determine the allowable point load on a given roof purlin or anywhere on the roof.

Note: The X-720 roof has an allowable snow load of 30 psf per drawing X-720-5-S, which is greater than the 20 psf being assumed for the X-744G roof, and the roof purlin spacing and span is similar to the X-744G (as shown on X-720-4-S), so the following will be considered the allowable (live) point loads for both the X-744G and X-720 roofs.

Per AISC Steel Construction Manual 14th Edition, Table 3-23:

1. Simple Beam – Uniformly Distributed Load
Mmax(Center) = w*((L^2)/8) = 133.4 lb/ft*((20ft^2)/8) = 6,670 lb-ft
Then this maximum moment is used to determine the maximum allowable point load.

7. Simple Beam – Concentrated Load at Center
Mmax(Center) = 6,670 lb-ft = PL/4 = (P*20ft)/4

P = 1,334 lbs (if TPO is not installed)

If the Thermoplastic Polyolefin (TPO) is put down, then 1 psf would need to be taken into account for this additional weight, so if the TPO is installed, then the maximum allowable point load would be as follows:
19psf*6.67ft = 126.73 lb/ft = "w"

Per AISC Steel Construction Manual 14th Edition, Table 3-23:

1. Simple Beam – Uniformly Distributed Load
Mmax(Center) = w*((L^2)/8) = 126.73 lb/ft*((20ft^2)/8) = 6,336 lb-ft
Then this maximum moment is used to determine the maximum allowable point load.

7. Simple Beam – Concentrated Load at Center
Mmax(Center) = 6,336 lb-ft = PL/4 = (P*20ft)/4

P = 1,267 lbs (if TPO is installed)

The roofing contractor will need to place equipment and materials including, but not limited to the following (weights are approximate/estimated and may vary):

- Mobile Fall Protection Cart (1,120 lbs)
- 4-Wheel Cart (250 lbs)
- Safety Boxes (approx. 800 lbs/Each)
- Generator (500 lbs/Each)
- TPO Rolls or material (315 lbs/Each)
- Underlayment Mat Rolls (200 lbs/Each)

All of these items are lighter than the maximum allowable point load on a purlin, which is 1,334 lbs (if TPO is not installed) or 1,267 lbs (if TPO is installed). Personnel must ensure that the weight of a person, equipment, and tools do not exceed the maximum point load allowed for a tributary area within one roof purlin/joist. So, ensure a minimum of 7 ft. between equipment/heavy loads in the north/south direction and 20 ft. minimum between equipment/heavy loads in the east/west direction. Workers need to distribute equipment/materials/personnel as much as possible to not heavily load a certain area.

Operability Recommendations:	**Changes to Design Docs Needed:** ☐ Yes ☒ No
Operable? ☐ Yes ☐ No ☒ N/A	**Affected Docs**

Implementation:	**Date Approved:** 8-14-18
Actions Required: ☐ Yes ☒ No	**Expiration Date:** –NA–
EIAW/IAW Number: N/A	**Next Review Date:** –NA–
USQD Screening Number: N/A	
USQD Number: N/A	

NOTE: If implementing actions are required, an EIAW/IAW number is also required to assure such actions are completed and do not violate certificate requirements and authorizations.

Non-Conforming Item Disposition:

- ☒ N/A
- ☐ Reject - Return To Supplier
- ☐ Repair
- ☐ Use-As-Is
- ☐ NCR VOID (Item conforms)
- ☐ Reject - Scrap/Dispose
- ☐ Rework
- ☐ Upgrade
- ☐ Documentation

Other Comments or Notes:

Attachments

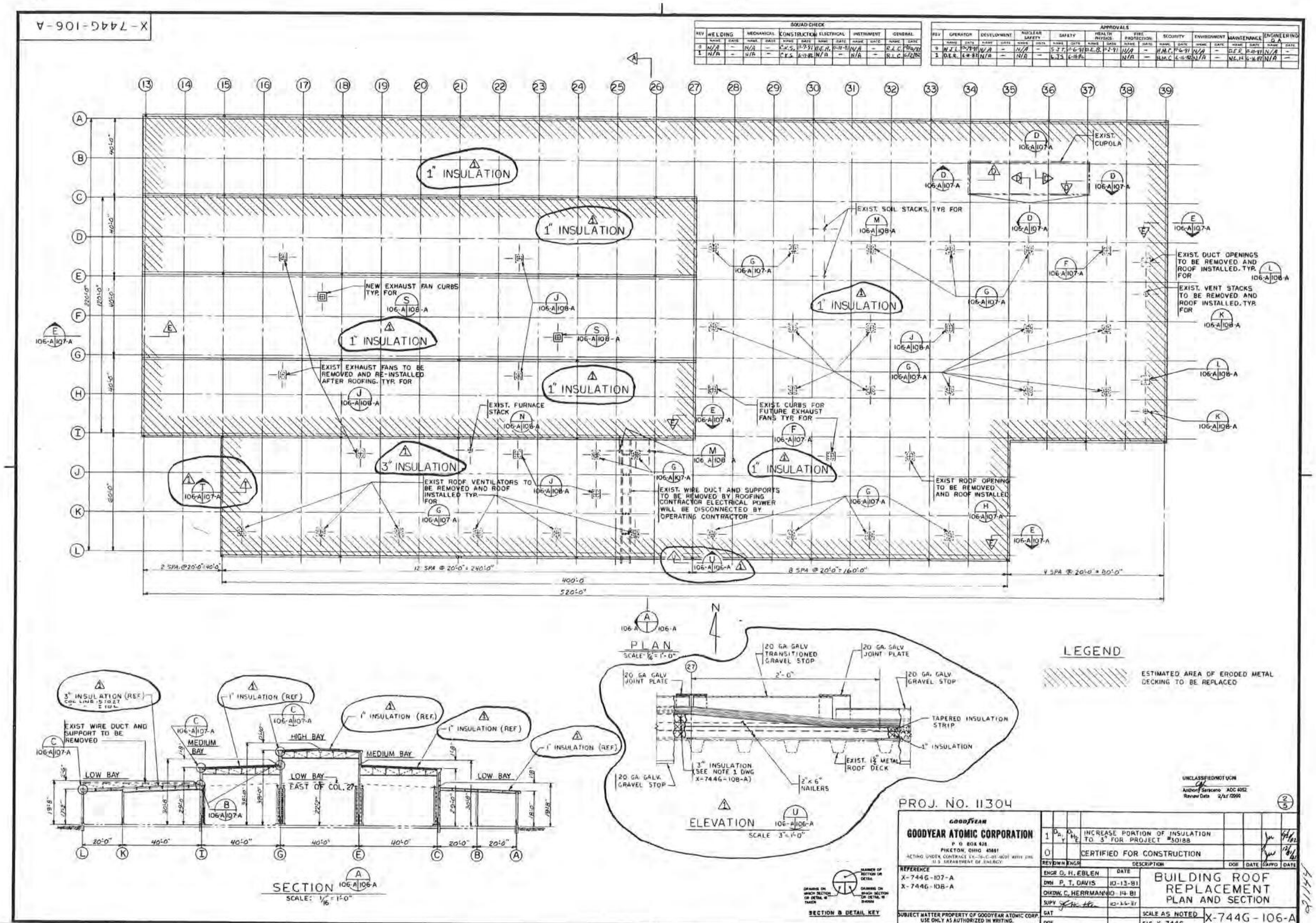
1) Drawings
2) AISC Reference Pages

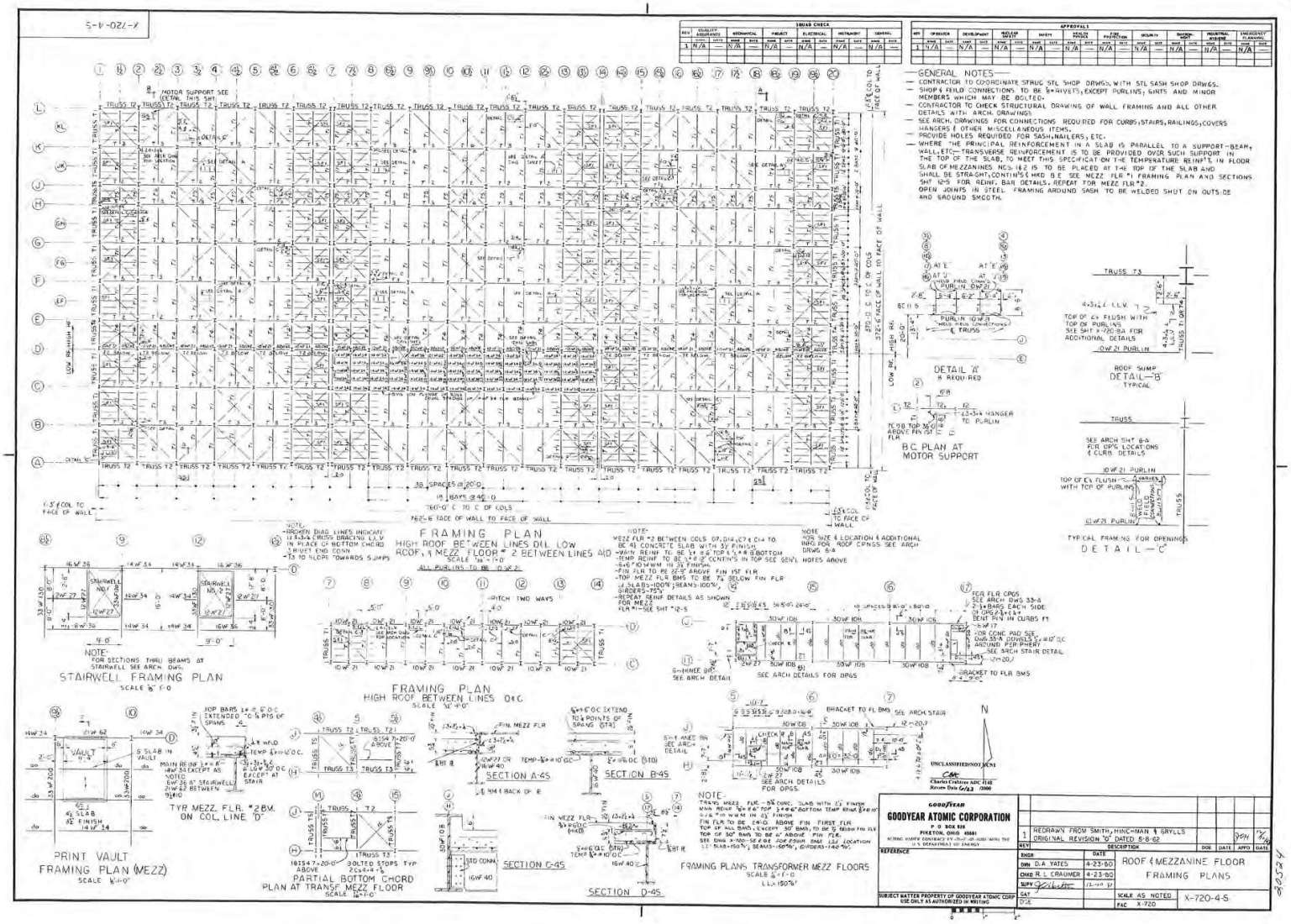
APPROVALS

AUTHOR: Ellen K. Stone / 8/14/18 — Ellen Stone
Signature/Date

REVIEWER: Dan O'Dell 8-14-18 — Daniel O'Dell
Signature/Date

APPROVER: Wayne E. Hacker 8-14-2018 — Wayne Hacker
Signature/Date


X-744G-106-A
1" INSULATION
3" INSULATION
NEW EXHAUST FAN CURBS TYP. FOR
EXIST. EXHAUST FANS TO BE REMOVED AND RE-INSTALLED AFTER ROOFING. TYP. FOR
EXIST. FURNACE STACK
EXIST. ROOF VENTILATORS TO BE REMOVED AND ROOF INSTALLED TYP. FOR
EXIST. WIRE DUCT AND SUPPORTS TO BE REMOVED BY ROOFING CONTRACTOR ELECTRICAL POWER WILL BE DISCONNECTED BY OPERATING CONTRACTOR
EXIST. CURBS FOR FUTURE EXHAUST FANS TYP. FOR
EXIST. SOIL STACKS, TYP. FOR
EXIST. CUPOLA
EXIST. DUCT OPENINGS TO BE REMOVED AND ROOF INSTALLED. TYP. FOR
EXIST. VENT STACKS TO BE REMOVED AND ROOF INSTALLED. TYP. FOR
EXIST. ROOF OPENING TO BE REMOVED AND ROOF INSTALLED
PLAN
SCALE: 1/16" = 1'-0"
LEGEND
ESTIMATED AREA OF ERODED METAL DECKING TO BE REPLACED
SECTION
SCALE: 1/16" = 1'-0"
LOW BAY
MEDIUM BAY
HIGH BAY
EAST OF COL. 27
EXIST. WIRE DUCT AND SUPPORT TO BE REMOVED
ELEVATION
SCALE 3" = 1'-0"
20 GA. GALV TRANSITIONED GRAVEL STOP
20 GA. GALV JOINT PLATE
20 GA. GALV GRAVEL STOP
TAPERED INSULATION STRIP
EXIST. 1½" METAL ROOF DECK
2" x 6" NAILERS
3" INSULATION (SEE NOTE 1 DWG X-744G-108-A)
PROJ. NO. 11304
GOODYEAR ATOMIC CORPORATION
P. O. BOX 628
PIKETON, OHIO 45661
INCREASE PORTION OF INSULATION TO 3" FOR PROJECT #30188
CERTIFIED FOR CONSTRUCTION
REFERENCE
X-744G-107-A
X-744G-108-A
ENGR G. H. EBLEN 10-13-81
DWN P. T. DAVIS 10-13-81
CHKD C. HERRMANN 10-14-81
BUILDING ROOF REPLACEMENT PLAN AND SECTION
SCALE AS NOTED
FAC. X 744G
X-744G-106-A
SECTION & DETAIL KEY
SUBJECT MATTER PROPERTY OF GOODYEAR ATOMIC CORP. USE ONLY AS AUTHORIZED IN WRITING.


X-720-4-S
ISSUED CHECK
APPROVALS
GENERAL NOTES
CONTRACTOR TO COORDINATE STRUC STL SHOP DRWGS. WITH STL SASH SHOP DRWGS.
SHOP & FEILD CONNECTIONS TO BE ¾" RIVETS, EXCEPT PURLINS, GIRTS AND MINOR MEMBERS WHICH MAY BE BOLTED.
CONTRACTOR TO CHECK STRUCTURAL DRAWING OF WALL FRAMING AND ALL OTHER DETAILS WITH ARCH. DRAWINGS.
SEE ARCH. DRAWINGS FOR CONNECTIONS REQUIRED FOR CURBS, STAIRS, RAILINGS, COVERS HANGERS & OTHER MISCELLANEOUS ITEMS.
PROVIDE HOLES REQUIRED FOR SASH, NAILERS, ETC.
WHERE THE PRINCIPAL REINFORCEMENT IN A SLAB IS PARALLEL TO A SUPPORT-BEAM, WALL, ETC- TRANSVERSE REINFORCEMENT IS TO BE PROVIDED OVER SUCH SUPPORT IN THE TOP OF THE SLAB, TO MEET THIS SPECIFICAT ON THE TEMPERATURE REINF'T IN FLOOR SLAB OF MEZZANINES NOS. 1 & 2 IS TO BE PLACED AT THE TOP OF THE SLAB AND SHALL BE STRAIGHT, CONTINUOUS & MKD BE SEE MEZZ FLR #1 FRAMING PLAN AND SECTIONS SHT 12-S FOR REINF. BAR DETAILS. REPEAT FOR MEZZ FLR #2.
OPEN JOINTS IN STEEL FRAMING AROUND SASH TO BE WELDED SHUT ON OUTSIDE AND GROUND SMOOTH.
DETAIL 'A' 8 REQ'D
B.C. PLAN AT MOTOR SUPPORT
ROOF SUMP DETAIL—B TYPICAL
TYPICAL FRAMING FOR OPENINGS DETAIL—C
FRAMING PLAN HIGH ROOF BETWEEN LINES D & L LOW ROOF & MEZZ FLOOR @ 2 BETWEEN LINES A & D
STAIRWELL FRAMING PLAN
FRAMING PLAN HIGH ROOF BETWEEN LINES D & C
PRINT VAULT FRAMING PLAN (MEZZ)
TYP MEZZ. FLR. @ 28M. ON COL. LINE 'D'
PARTIAL BOTTOM CHORD PLAN AT TRANSF MEZZ FLOOR
SECTION A-4S
SECTION B-4S
SECTION C-4S
SECTION D-4S
FRAMING PLANS TRANSFORMER MEZZ FLOORS
GOODYEAR ATOMIC CORPORATION
P. O. BOX 628
PIKETON, OHIO 45661
REDRAWN FROM SMITH, HINCHMAN & GRYLLS ORIGINAL REVISION '0' DATED 5-8-62
ROOF & MEZZANINE FLOOR FRAMING PLANS
SCALE AS NOTED
X-720-4-S

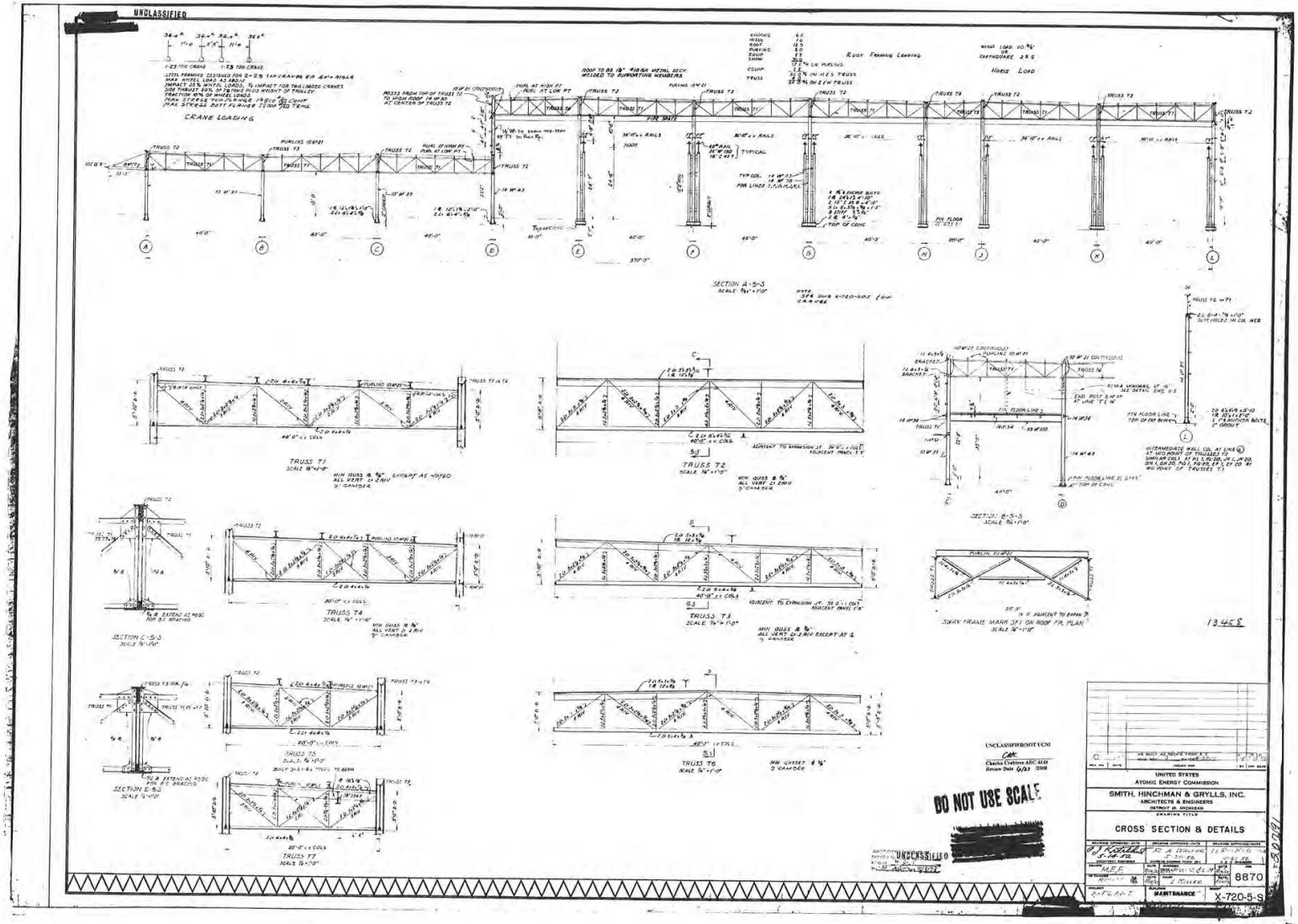
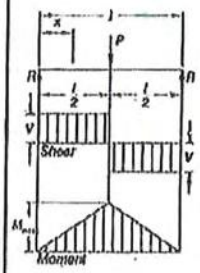

UNCLASSIFIED
CRANE LOADING
ROOF FRAMING LOADING
LIVE LOAD
SECTION A-S-3
SCALE 3/16"=1'0"
TRUSS T1
SCALE 3/8"=1'0"
TRUSS T2
SCALE 3/8"=1'0"
SECTION B-S-3
SCALE 3/16"=1'0"
SECTION C-S-3
SCALE 3/16"=1'0"
TRUSS T4
SCALE 3/8"=1'0"
TRUSS T3
SCALE 3/8"=1'0"
SWAY FRAME MARK SF1 ON ROOF FR. PLAN
SCALE 3/8"=1'0"
SECTION E-S-3
SCALE 3/16"=1'0"
TRUSS T5
SCALE 3/8"=1'0"
TRUSS T7
SCALE 3/8"=1'0"
DO NOT USE SCALE
UNCLASSIFIED
UNITED STATES
ATOMIC ENERGY COMMISSION
SMITH, HINCHMAN & GRYLLS, INC.
ARCHITECTS & ENGINEERS
DETROIT 26, MICHIGAN
CROSS SECTION & DETAILS
13455
8870
X-720-S-S

Table 3-23 (continued)
Shears, Moments and Deflections

7. SIMPLE BEAM — CONCENTRATED LOAD AT CENTER



Total Equiv. Uniform Load ..... $= 2P$

$R = V$ ..... $= \frac{P}{2}$

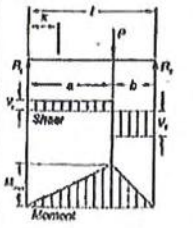
M_{max} (at point of load) ..... $= \frac{Pl}{4}$

M_x (when $x < \frac{l}{2}$) ..... $= \frac{Px}{2}$

Δ_{max} (at point of load) ..... $= \frac{Pl^3}{48EI}$

Δ_x (when $x < \frac{l}{2}$) ..... $= \frac{Px}{48EI}(3l^2 - 4x^2)$

8. SIMPLE BEAM — CONCENTRATED LOAD AT ANY POINT



Total Equiv. Uniform Load ..... $= \frac{8Pab}{l^2}$

$R_1 = V_1$ ($= V_{max}$ when $a < b$) ..... $= \frac{Pb}{l}$

$R_2 = V_2$ ($> V_{max}$ when $a > b$) ..... $= \frac{Pa}{l}$

M_{max} (at point of load) ..... $= \frac{Pab}{l}$

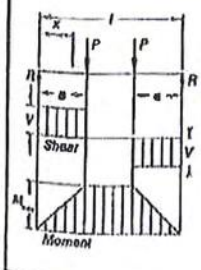
M_x (when $x < a$) ..... $= \frac{Pbx}{l}$

Δ_{max} $\left(\text{at } x = \sqrt{\frac{a(a+2b)}{3}}, \text{when } a > b\right)$ ..... $= \frac{Pab(a+2b)\sqrt{3a(a+2b)}}{27EIl}$

Δ_a (at point of load) ..... $= \frac{Pa^2b^2}{3EIl}$

Δ_x (when $x < a$) ..... $= \frac{Pbx}{6EIl}(l^2 - b^2 - x^2)$

9. SIMPLE BEAM — TWO EQUAL CONCENTRATED LOADS SYMMETRICALLY PLACED



Total Equiv. Uniform Load ..... $= \frac{8Pa}{l}$

$R = V$ ..... $= P$

M_{max} (between loads) ..... $= Pa$

M_x (when $x < a$) ..... $= Px$

Δ_{max} (at center) ..... $= \frac{Pa}{24EI}(3l^2 - 4a^2)$

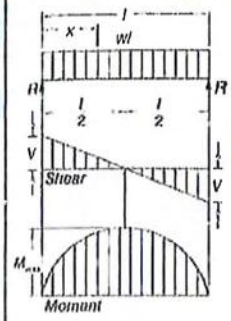
Δ_{max} (when $a = \frac{l}{3}$) ..... $= \frac{Pl^3}{26EI}$

Δ_x (when $x < a$) ..... $= \frac{Px}{6EI}(3la - 3a^2 - x^2)$

Δ_x (when $a < x < (l - a)$) ..... $= \frac{Pa}{6EI}(3lx - 3x^2 - a^2)$

Table 3-23
Shears, Moments and Deflections

1. SIMPLE BEAM — UNIFORMLY DISTRIBUTED LOAD



Total Equiv. Uniform Load ..... $= wl$

$R = V$ ..... $= \frac{wl}{2}$

V_x ..... $= w\left(\frac{l}{2} - x\right)$

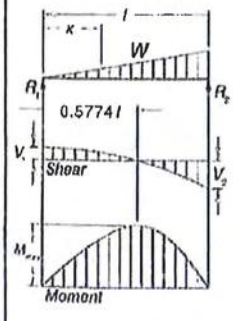
M_{max} (at center) ..... $= \frac{wl^2}{8}$

M_x ..... $= \frac{wx}{2}(l - x)$

Δ_{max} (at center) ..... $= \frac{5wl^4}{384\,EI}$

Δ_x ..... $= \frac{wx}{24\,EI}\left(l^3 - 2lx^2 + x^3\right)$

2. SIMPLE BEAM — LOAD INCREASING UNIFORMLY TO ONE END



Total Equiv. Uniform Load ..... $= \frac{16\,W}{9\sqrt{3}} = 1.03\,W$

$R_1 = V_1$ ..... $= \frac{W}{3}$

$R_2 = V_2 = V_{max}$ ..... $= \frac{2W}{3}$

V_x ..... $= \frac{W}{3} - \frac{Wx^2}{l^2}$

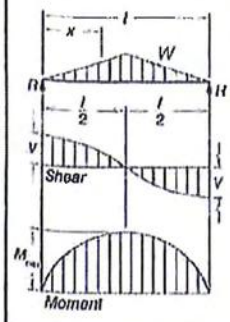
M_{max} $\left(\text{at } x = \frac{l}{\sqrt{3}} = 0.557\,l\right)$ ..... $= \frac{2Wl}{9\sqrt{3}} = 0.128\,Wl$

M_x ..... $= \frac{Wx}{3l^2}\left(l^2 - x^2\right)$

Δ_{max} $\left(\text{at } x = l\sqrt{1 - \sqrt{\frac{8}{15}}} = 0.519\,l\right)$ ..... $= 0.0130\,\frac{Wl^3}{EI}$

Δ_x ..... $= \frac{Wx}{180\,EIl^2}\left(3x^4 - 10l^2x^2 + 7l^4\right)$

3. SIMPLE BEAM — LOAD INCREASING UNIFORMLY TO CENTER



Total Equiv. Uniform Load ..... $= \frac{4\,W}{3}$

$R = V$ ..... $= \frac{W}{2}$

V_x (when $x < \frac{l}{2}$) ..... $= \frac{W}{2l^2}\left(l^2 - 4x^2\right)$

M_{max} (at center) ..... $= \frac{Wl}{6}$

M_x (when $x < \frac{l}{2}$) ..... $= Wx\left(\frac{1}{2} - \frac{2x^2}{3l^2}\right)$

Δ_{max} (at center) ..... $= \frac{Wl^3}{60\,EI}$

Δ_x (when $x < \frac{l}{2}$) ..... $= \frac{Wx}{480\,EIl^2}\left(5l^2 - 4x^2\right)^2$